CASE REPORT CRSLS

Robotic Repair of an Acquired Abdominal Intercostal Hernia

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ABSTRACT

Introduction: Intercostal hernias are a rare clinical entity. They are divided into trans-diaphragmatic intercostal or abdominal intercostal hernias based upon the presence or absence of diaphragmatic injury. There are various means of repair for these hernias, including open, laparoscopic, and robotic approaches. We present the second known robotic repair of an abdominal intercostal hernia and review of the relevant literature.

Case Description: A 54-year-old morbidly obese male was found to have an abdominal intercostal hernia on the right between the 9th and 10th ribs. His symptoms were significant for a large, tender right chest wall mass. Through a three-port approach, polypropylene mesh and circumferential sutures were used to create a double-wall of reinforcement to secure the area of weakness.

Discussion: This rare case of an intercostal hernia utilized robotic-assisted laparoscopic repair and led to a favorable outcome, whereby the patient reported significant improvement in pain, comfort, and quality of life. Thus, minimally invasive robotic surgery for this complex structural pathology can be safer and have less complications than other current treatments.

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INTRODUCTION

Intercostal hernias are a rare clinical entity with few isolated case reports in the literature.[1] The first cases of intercostal hernias were described in 1946 resulting from penetrating trauma and gunshot wounds.[2,3] Intercostal hernias may arise from blunt or penetrating trauma, as well as iatrogenic causes such as open nephrectomy, neuromuscular weakness, or local injury such as coughing.[4] Additionally, massage, heavy lifting, and bull gore related injuries leading to intercostal hernia have also been described.[4]

Intercostal hernias are delineated by the presence or absence of diaphragmatic injury as either trans-diaphragmatic intercostal hernias or abdominal intercostal hernias (AIH), respectively. The two conditions may present with different clinical features and should be considered different entities.[5,6]

Our case is the 22nd AIH in the literature, and the fourth to develop an abdominal intercostal hernia as a result of excessive coughing.[6] The primary treatment option for intercostal herniation is surgical; however, no single surgical repair option has been shown to be ideal due to the rarity of the condition.[7] Laparoscopic and open repairs have been described for intercostal hernias, but the advancement of robotic surgery may allow for a third option in repair of these rare entities.[7,8] We present the second known case of robotic repair of an abdominal intercostal hernia resulting in a successful treatment.

Case Presentation

In this case, a 54-year-old morbidly obese male presented to the office with a large, painful mass of his right lower chest wall, interfering with day-to-day activities and his quality of life. The patient had pneumonia several months prior to presentation, with a particularly strenuous episode of excessive coughing, with subsequent ecchymosis

of the right flank and severe pain in his right rib cage. Subsequent to the coughing episode, the patient noted worsening pain and a steadily enlarging bulge of his right chest wall. The patient had an initial body mass index (BMI) of 37.6. Physical examination revealed a large, approximately 15 × 20 cm defect and herniation between ribs 9 and 10, with a reducible bulge. Computed tomography (CT) demonstrated a large, right intercostal hernia between ribs 9 and 10 containing liver and ascending colon **[Figure 1]**. Various approaches were discussed with the patient, including open repair and laparoscopic or robotic repair; we decided to pursue a robotic approach, which would allow for mesh-based herniorrhaphy and would avoid the need for trans-fascial sutures or intra-abdominal tacks, which based upon the hernia's location, may irritate or injure the intercostal nerves, the periosteum of the ribs, or the diaphragm.

The patient utilized an abdominal binder for support, and through dietary modifications lost weight prior to surgical repair. After weight loss to a BMI of < 30, the patient underwent a robotic-assisted laparoscopic intercostal hernia repair. Upon initial inspection, a large, approximately 15 x 20 cm ovoid-shaped intercostal weakness was noted between ribs 9 and 10. The fact that the defect was too large to be closed, and the ribs would not allow closure meant that the repair had to be conducted through mesh reinforcement. Through a three-port approach, a 25 × 30 cm piece of dual-layered polypropylene mesh was used to buttress the weakened intercostal space. The mesh was delivered through a 12 mm port and was secured circumferentially over the area of weakness with an absorbable self-locking suture, with at least 4 cm of space for overlap on all borders of the hernia. Standard, small bites of the needle were through the peritoneum and judiciously into the muscle, with particular care taken to avoid injury to the nerves and periosteum of adjacent ribs. The mesh was further secured with a second layer of circumferential interrupted simple sutures of absorbable braided suture. The patient was admitted postoperatively for observation and was discharged home on postoperative day one.

The patient was contacted for telemedicine follow-up, where he was found to have significant improvement in his pain and discomfort. He reported tolerable postoperative pain and had patient-controlled analgesia with Dilaudid® on-demand, as well as a transversus abdominis plane block. He continued appropriate weight loss postoperatively, and over time was able to return to his normal activities without restriction.

DISCUSSION

Intercostal hernias are rare clinical entities characterized by lung and/or abdominal contents protruding through an intercostal defect. Intercostal hernias are further delineated into congenital, lung, transdiaphragmatic, and AIH. The term abdominal intercostal hernia is reserved for when no diaphragmatic injury has occurred.[5,6]

Our patient's hernia repair was not completely approximated due to the increased intercostal space from the initial insult. There was asymmetry still present, but the uncomplicated postoperative course coupled with the lack of in-person follow-up due to COVID-19 meant that additional imaging was not obtained. However, in telemedicine follow-up interviews our patient endorsed significantly less pain and discomfort in the 6-month postoperative period.

AIHs tend to develop under the ninth rib with a nonsignificant preference to the left side. It has been suggested the buttressing effect of the liver's right lobe may lead to moderate left-sided dominance of AIHs.[3] An important consideration is the interaction between the liver and mesh prosthesis. The additional support provided by the mesh adjacent to the liver could increase stability enough to decrease the likelihood of recurrence in that specific area, but the long-term effects are unclear. Most cases of AIH result from major or minor trauma (stab wounds, coughing, etc) but about 20% seem to occur spontaneously.[5] Patients who developed AIH after minor trauma typically had multiple predisposing conditions.[3] Obesity, age, previous surgery, scoliosis, collagen vascular disease, smoking, asthma, and chronic obstructive pulmonary disease, have been implicated as predisposing factors to AIH formation.

The most recent literature review on intercostal hernias by Erdas et al. shows the emerging characteristics of a "typical" AIH clinical presentation, which aligns closely with our case. In their review, patients were mostly male (60%), with a mean age of 58 years, and presented with swelling and pain. Erdas et al. also show 75% of AIHs developing below the ninth rib, with the left side being the slightly more affected side. Contents mostly contained liver, omental fat, and bowel loops. Our case is notable given the presence of both liver and right colon in the hernia, which has not been reported before.

Computed tomography (CT) is generally the most employed diagnostic tool, but ultrasound may offer an alternative when clinical presentation is straightforward. The intercostal hernia bulge and typical presentation of chest swelling may not be easily detectable in obese

Figure 1. Coronal image from computed tomography scan demonstrating right-sided abdominal intercostal hernia with herniated liver and colon.

patients. A high degree of clinical suspicion is also required to differentiate AIH from lipomas or hematomas on physical examination. Out of 20 described AIHs, 5 patients received initially incorrect diagnoses including generic ileus and hematoma.[8]

Treatment algorithms for repair of intercostal hernias depend upon any diaphragmatic injury, the nature of the hernia, the degree of symptoms, and the size of the hernia. For symptomatic patients, surgical repair is the treatment of choice. Excluding our report, 16 surgical cases of AIH have been described: 11 were performed in an open fashion, four were repaired laparoscopically, and one robotic besides our patient. Due to the rarity of the disease, the best means of repair has yet to be fully elucidated. In their case report on a laparoscopic AIH repair, Dan et al. recommends a tension-free mesh repair as a first-choice technique, which was also decided upon for our patient. Additionally, absorbable sutures were used in order to avoid the potential for chronic pain associated with permanent sutures.[9] Typically, sutures are needed just until the mesh can be incorporated into the abdominal wall, and this can be accomplished by absorbable sutures, without retention of permanent sutures that can potentially delay or prolong recovery.

Abdominal surgery poses a significantly increased risk for the development of adhesions, among other complications such as infection, mesh rejection, hernia recurrence, and fibrosis.[10] The potential for adhesion formation has been an area of increasing attention and concern. There are currently multiple meshes available with different indications and advantages. The Symbotex™ composite monofilament mesh used for our patient was coated with oxidized cellulose which is an adhesion barrier. These measures ensured that our patient would be less likely to develop postoperative adhesions.

Recurrence occurred in 28.6% of patients regardless of approach and technique with mean follow up at 8.6 months.[7] It is currently not well-understood how to avoid peri-and postoperative recurrence due to the rarity of the condition. The same standard principles of herniorrhaphy were utilized to treat our patient. With the advantages of minimally invasive surgery, including less postoperative pain, shorter hospital stays, and quicker return to normal activity, a laparoscopic or robotic approach may prove to be the procedure of choice.[5] The robotic platform allows for dexterous endowrist manipulation to allow for greater control when suturing mesh intracorporeally, and may be a good choice for appropriate patients, especially those with complicating factors, when available. Furthermore, a minimally invasive technique may reduce the risk of nerve and vascular injury that can lead to muscle atrophy and subsequent recurrent herniation.[10]

Due to the rarity of this condition and the involvement of multiple intraperitoneal structures, we are not currently able to predict how the mesh will fundamentally change in the case of continued weight loss in this patient.

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